DISTRIBUTION OF TRIMETHYLAMINE OXIDE IN SOME MARINE AND FRESHWATER FISH

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ABSTRACT

The distribution of trimethylamine oxide (TMAO) in some marine and freshwater fish species has been reported. Among the marine species, fish belonging to the class elasmobranchs, teleosts and crustacea were studied. It was observed that all marine fish species had appreciable amount of TMAO whereas in the freshwater fish the amount was insignificant. The significance of these results has been discussed.

INTRODUCTION

MARINE fish and very few freshwater fish contain substantial amounts of TMAO and the determination of the degradation product trimethylamine (TMA) has been used as a specific index of bacterial spoilage[1]. Extensive experiments on stored cod or sampled from the market have provided a statistical relationship between TMA and sensory scores[2,3].

Thus the original concentration of TMAO in fish muscle would be of value as it has indirect influence on its quality. The total volatile bases (TVB) and TMAO content of a few Indian fishes were reported earlier[4–7]. However the estimation of TVB carried out by these workers was by microdiffusion method which is considered less accurate and less sensitive than the picrate method[8]. Moreover very few Indian fish species have been studied so far.

The aim of the present investigation was to estimate the amount of TMAO in some Indian fish species using the picrate method. As the variability of TMA is influenced by biological variations in the concentrations of precursors it was thought that TMAO values could be of use to predict the shelf life of stored fish[1,9]. This information could be valuable to the fisheries industry.

MATERIALS AND METHODS

Fresh marine fish were obtained from Sasoon dock and Versowa landing sites of Bombay coast and freshwater fish were caught from a lake at Thana and preserved in ice. All reagents used were of analytical grade.

The fish were beheaded, gutted and 10 g of the white muscle were homogenised in a waring blender with distilled water (2 ml/g meat). Homogenate was centrifuged at 3000 rpm and 8 ml supernatant was mixed with 2 ml of 20% HCHO. This was used for analysis.

One ml of 25% HCl and 0.5 g of Devarda's alloy were added to 5 ml extract and kept in boiling water bath for 15 min. TMAO was reduced to TMA[8]. The solution was cooled and filtered. The filtrate and washings were collected and made upto 100 ml. TMA concentration before and after reduction of TMAO was estimated by the picrate method[10].

Extracts of 1 ml each was taken in stoppered polythene tubes with 3 ml of distilled water, 1 ml 20% HCHO, 10 ml toluene and 3 ml saturated K_2CO_3. After vigorous mixing, 7 ml of toluene layer was transferred to another polythene tube containing 0.3–0.4 g granular anhydrous Na_2SO_4 and mixing repeated. Five ml of this toluene was mixed with 5 ml of 0.02% picric acid in another polythene tube and the colour obtained read at 420 nm using Carl Zeiss PMQII spectrophotometer. Three samples of muscle mince were analysed for each fish and two fish were studied in each species.

RESULTS AND DISCUSSION

The values of TMAO content for elasmobranchs reported in the present study differ significantly from values of some workers[8,11,12]. The highest amount of TMAO reported[11] for some species of elasmobranchs were in the range from 1–1.4 g/100 g of muscle. However these species were not studied in this investigation.

There was a wide variation in the TMAO content of

different fish species belonging to the class elasmobranch, teleost and crustacea (table 1–3).

It was reported[10] that fishes of gadidae family contain the largest amount of TMAO among teleost fish and the lower order contain less TMAO than those of higher order. These observations agree with present findings (table 2).

The TMAO values for teleosts from the east coast of India[6] were quite comparable with values obtained in this study and those reported for fish from the west coast of India[7].

The TMAO content of only a few species of crustaceans have been analysed and the very low values are reported[6] in them from the east coast of India. However, these species were different from those analysed in this investigation.

The TMAO content reported[13] in prawns, *parapenaeopsis stylifera*, caught from the sea off Cochin was much lower than those obtained in this study (table 3). Similarly lower values of TMAO were reported[7] by other workers for this species of prawns from other coastal areas of India.

In the case of lobster, *panulirus ornates* from the east coast of India, the TMAO content[6] was much higher than the values reported in this investigation (table 3).

Among the freshwater fish analysed except for catfish, *clarius batrachus*, the TMAO content of other fish species was practically insignificant (table 4). The most commonly consumed freshwater fish like *labeo rohita* (rohu), *cirrhina mrigala* (mrigal) and *catla catla* (catla) have insignificant amounts of TMAO. This data supports the view that freshwater fish have very low amounts of TMAO[9].

The results presented agree with the suggestion that the TMAO content can show a wide variation among fish species depending on the size of the fish[10], environmental conditions and probably type and availability of nutrition[14,15]. Further in some cases, for the same fish species from different coasts of India,

Table 1 *TMAO content of Elasmobranch (marine fish)*

	mg/100 g of muscle
Name of species	TMAO content (mean ± range)
Scoliodon Sorrakowah	136.7 ±2.1
Sphyrna zygaena	176.1 ±3.6
Chiloscyllium indicum	76.5 ±3.2
Rhynchobatus djiddensis	56.9 ±1.8
Trygon zugei	65.3 ±5.2
Narcine timlei	55 0 ±0.2
Rhinobatus armatus	78.3 ±2.8

Table 2 *TMAO content of Teleost (marine fish)*

	mg/100 g of muscle
Name of species	TMAO content (mean ± range)
Hilsa sinensis	11 5 ±0.8
Otolithus argenteus	46.1 ±2.0
Harpodon nehereus	19.0 ±1.1
Mugil dussumieri	9.1 ±0.9
Pampus argenteus	44.4 ±1.1
Pseudosciaena diacanthus	67.1 ±3.2
Scomberomorus guttatus	49.1 ±1.1
Eleutheronema tetradactylum	32.1 ±1.5
Rastrelliger kanagurta	22.6 ±2.7
Trichiurus savala	53.4 ±0.5
Cynoglossus semifasciatus	40.9 ±1.0
Coilia dussumieri	30.0 ±2.8
Megalaspis cordyala	39.6 ±1.7
Platycephalus indicus	46.5 ±0.6
Parastromateus niger	44.9 ±2.2
Chirocentrus dorab	31.3 ±1.9
Caranx carangus	48.9 ±3.6
Sphyraena obtusata	49.0 ±3.0
Decapterus russellii	26.1 ±0.3
Sardinella longiceps	29.8 ±2.6
Therapon jarbus	28.7 ±2 4
Psettodes erumei	49.6 ±4.3

Table 3 *TMAO content of crustacea (marine fish)*

	mg/100 g of muscle
Name of species	TMAO content (mean ± range)
Scylla serrata	20.4 ±0.6
Panulius ornates	13.8 ±0.7
Parapenaeopsis stylifera	141.3 ±6.1
Palaemon concinnus	45.7 ±1.7
Metapenaeus monoceros	22.5 ±1.5

Table 4 *TMAO content of some freshwater fish*

	mg/100 g of muscle
Name of species	TMAO content (mean ± range)
Catla catla	4 6 ±0.6
Labeo rohita	*7.8* ±0 9
Cirrhina mrigala	3.5 ±1.1
Cirrhina reba	Not present
Clarias batrachus	12.9 ±1.4
Tilapia mossumbica	4.9 ±0.5

there was difference in the concentrations of TMAO. This could probably be due to the differences in environment at the different fishing grounds from where the catch was obtained. The different methods available for the analysis of TMAO could also contribute to some degree of variation in results.

Since the volatile amines are important as an index of quality of fish and as they are derived from TMAO either by the action of enzymes present in fish muscle[9] or in bacteria[10] or due to some non-enzymic reactions[17], the data of TMAO presented could prove useful as reference values for predicting the shelf life of fish catch. This has scope in the commercial fishing industry.

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ANNOUNCEMENTS

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The Third International Tinplate Conference will be held at the Europa Hotel, London in the week commencing 15th October, 1984. A leaflet giving advance notice and details with a booking form for submission of papers is available now from the Institute.

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WAVE SOLDERING SURFACE-MOUNTED COMPONENTS

The increasing miniaturisation of electronic circuits has been made possible partly by the introduction of smaller discrete components, such as resistors and capacitors, in the form of leadless chips that are surface-mounted to the normal underside of a printed circuit board. These chip components are designed to be compatible with the wave soldering process, but their use presents certain problems that must be overcome in order to achieve fault-free soldering. (Tin and Its Uses, No. 138, 1983)